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SILVICAL LEAFLET 19.

BIGTREE.

Sequoia washingtoniana (Winsl.) Sudw.

Bigtree, though not of very great commercial importance, is of peculiar interest, because it grows to a greater size and age than any other tree in the world. It is the survivor of another age, and was once widely distributed, but it is now rare and found only in a few groves in the Sierras of California. The inroads upon it by lumbermen have increased its rarity and even threatened it with extinction. Public interest, however, has been sufficient to cause the preservation of a number of important groves as national parks, and most of the other groves are now included within the National Forests.

Although its wood has valuable qualities, very similar to those of redwood (*Sequoia sempervirens*), its close relative of the Pacific coast, such as lightness, ease of working, straight, fine, even grain, handsome color, and resistance to insects, fungi, and fire, yet its enormous size and inaccessibility render it not profitable for logging. In the northern part of its range it occurs in small numbers and reproduces so unwillingly that it is not and will not become an important factor in the future commercial management of these forests. But farther south, where in places it forms a considerable part of the stand and where it reproduces strongly and freely, its rapid growth and other silvicultural qualities make it an easy and advantageous species to favor in handling the forest.

RANGE AND OCCURRENCE.

Bigtree occurs in 26 more or less isolated groves distributed for a distance of about 260 miles along the western slope of the Sierra Nevada Mountains in central California, from the middle fork of the American River on the southern border of Placer County in the north

to the head of Deer Creek, Tulare County, in the south. It extends from an altitude of 4,500 feet in the valley of the middle Tule River to an elevation of 8,400 feet in the other parts of its range, but is most abundant between 5,500 and 6,500 feet above the sea. It flourishes at increasingly higher altitudes the farther south it grows. None of the groves are more than a few square miles in extent, and most of them are separated from one another by gaps several miles wide, with only a few straggling specimens. Between the larger northern groves there are breaks from 40 to 60 miles in width. From Kings River in Fresno County southward the groups of trees are less widely separated, and a broad belt more or less occupied by the tree extends southward for 70 miles across the rough basins of the Kaweah and Tule rivers. The gaps between the northern groves are the former beds of glaciers which flowed down from the crest of the high main ridge of the Sierras during the glacial epoch. The existing groves occupy the higher lands from which the ice melted long before its disappearance from the intervening valleys.

The situations preferred by bigtree are the slopes and pockets near the headwaters of streams, where favorable moisture conditions exist. It is found mainly on northern and northwestern exposures. It prefers the moisture conditions found in heavy, dense forest and does not grow in open, exposed stands.

CLIMATE.

The habitat of bigtree is cooler and drier than that of redwood. At Summit, situated near the northern limit of its range at an elevation of 7,000 feet, the temperature occasionally falls to 12° F., and never exceeds 100°. The precipitation varies with the altitude, and from year to year from 18 to over 60 inches. Snow falls throughout the range of bigtree, and at high altitudes is often very heavy. The winters are long but mild, and the flowering and pollination of bigtree take place as early as February or March, although spring weather does not commence until considerably later.

ASSOCIATED SPECIES.

Bigtree does not grow in pure stands, but is everywhere associated with sugar pine, yellow pine, white fir, and incense cedar, which usually outnumber it greatly.

HABIT.

During the first four or five centuries of its growth the tapering stem of bigtree through nearly its entire length is covered with slender crowded branches, pointing upward at the top of the tree, horizontal at its middle, and drooping near the base of the trunk. The stems

of mature trees are straight and cylindrical and clear of branches for from 100 to 150 feet. They are coarsely fluted and decidedly buttressed at the base. The crowns of old trees become dense, dome-shaped, narrow masses of short horizontal branches, but lose their symmetry with age, when they become more open and picturesquely irregular, with flattened tops and massive misshapen branches.

The largest specimen of bigtree which has been measured has a height of 325 feet and a maximum diameter of 35 feet. Trees with an average diameter of 20 feet and a height of 275 feet are not uncommon, and these dimensions probably represent the average size of mature bigtrees.

SOIL AND MOISTURE.

Depth of soil and abundance of moisture are conditions most favorable to the development of bigtree. The groves frequently occupy draws and rock basins in which deep, porous soils have accumulated, and into which water drains from the surrounding ridges. Some groves cover rocky slopes in shallow soils, but trees are rarely found on the drier slopes or on rocky ridges.

Seedlings and saplings of bigtree are exacting in their moisture requirements, and are found chiefly along streams and in moist situations in the forest, and only occasionally on dry and unwatered slopes. Aside from moisture content, soil conditions appear to have no decided influence on the development of the young growth, for saplings grow up with equal success in deep, moist soil, upon rocky and stony stream beds, and on bare and often rocky, cut-over land where the mineral soil is exposed by fire.

TOLERANCE.

For successful development bigtree requires an abundance of light. It is more shade enduring in youth than in old age, but under dense shade even the young plants show by their slow growth, sparse foliage, flattened crowns, and gnarly habit the need of a good supply of light. Under a moderate amount of shade saplings retain their branches for some time and grow rapidly both in height and diameter, but an excess of shade will kill them. With a full supply of light young trees have heavy foliage and are close-branched to the ground. By the time the trees are larger they are so spaced that they are able to receive full side light on their crowns.

GROWTH AND LONGEVITY.

Bigtree reaches an age greater than that of any other living thing. A maximum age of more than four thousand years has been determined by counting the annual rings on a fire-scarred stub in the Kings

River forest. Most mature trees are much younger, however, and the normal age of maturity is probably not over fifteen hundred years.

Seedlings grow slowly during their first year, and usually reach a height of from one-half inch to 3 inches in that period, but subsequent growth is more rapid, 5 to 6 inches the second year and 6 to 12 inches during the third season. In exceptional situations 4-year-old seedlings have been found 6 feet high. During the sapling stage a bigtree is capable of making an annual height growth of 2 feet. As to diameter growth, bigtree is moderately rapid, but the large trees require about twelve years to grow an inch in diameter.

SUSCEPTIBILITY TO INJURY.

The persistence of the bigtree and its health and soundness are evidences of its freedom from the attack of enemies. Practically the only injury from the organic world to which it is subject is a brown rot disease of the heartwood, which sometimes hollows out large trees, without killing them, however.

Ground fires kill the sapling growth, but large trees are not destroyed; their immensely thick bark and the noninflammable quality of the wood carry them through many-times-repeated conflagrations with practically no injury beyond the scars on their butts.

REPRODUCTION.

Grown in the open, bigtree may begin to bear fertile seed as early as the eighteenth year. In the forest, cone production commences much later and good seed is not borne much before the two-hundredth year, but is continued until the tree is very old. Seed production is more abundant with bigtree than with any other conifer of the Sierras. As a rule, many cones are borne each year, and though in some seasons the seed crop is poor, this deficiency is compensated by years of enormously plentiful production at short intervals. The winged seeds are freed from the cones in the autumn and disseminated by the wind. The abundant and frequent production of seed, together with its carrying qualities, enable the tree to replace itself where cuttings or burns have denuded portions of the groves.

For germination the seed requires mineral soil, free from heavy accumulations of litter. Practically no seedlings are to be found except in openings where trees have fallen or burned out, and along charred, prostrate trunks. Reproduction is uniformly best in burned areas where the flames have bared the mineral soil. In the General Grant National Park a typical square rod contained 2,596 1-year-old seedlings, one-half to 3 inches high, stocked the preceding year after a light ground fire.

The very dense cover of snowbrush (*Ceanothus cordulatus*) which comes in on burns in the bigtree cuttings does not prevent the growth of the reproduction. Owing to its seeding capacity, the bigtree reproduction comes in before the brush, and although the bushes thicken over the seedlings, and the latter grow slowly, somewhat suppressed by the shade, they gradually push up through the cover. In brush-grown cuttings there is often a thrifty sapling growth standing over the undergrowth and smaller reproduction.

In the more northern groves—north of Kings River—there is almost no reproduction of bigtree, while to the south the reproduction is usually abundant and excellent. More favorable climatic conditions in the south are probably the reason for this difference.

Bigtree, in unexpected contrast to the redwood, does not produce suckers or sprouts.

MANAGEMENT.

Every effort should be made to preserve the characteristic groves of large old trees of this species, wherever they occur in their natural condition, because of their unique interest and æsthetic value, if for no other reason. In some parts of its range, however, bigtree is sufficiently abundant to allow conservative cutting without serious encroachment on the virgin stands.

Toward the northern part of its range the tree is too infrequent to be of economic importance in the management of the forests. But toward the south it is much commoner, and since it is as valuable a species as its associates and is adapted to silvicultural treatment, the mixed forest in which it occurs should be so managed that the proportion of bigtree may be increased, and the future stand may become a mixed forest of sugar and yellow pines and bigtree. Where the forest is cut clean, seed trees of these three species should be left and the whole area burned over to prepare the soil for the reception of seed. In areas where there is volunteer reproduction on the ground at the time of the cutting, care should be taken to keep fire out. The brush should be piled and burned in the vacant spots between the groups of reproduction. The area should be protected from fire until the seedlings and saplings reach a size at which they can no longer be damaged by the fires.

[Leaf. 19]

